A NEW PINNIPED FROM THE UPPER PLIOCENE OF CALIFORNIA

By Remington Kellogg

During the month of December, 1920, the writer, in company with Mr. E. L. Furlong, spent several days examining California collections of marine mammals. This work was undertaken under the auspices of the Carnegie Institution of Washington and under the direction of Dr. John C. Merriam. Although search for pinniped remains was not the principal object of this trip, a number of fossils were located, among which the most important were contained in the collection of Stanford University. These specimens were generously placed at the writer's disposal for study and description by Dr. David Starr Jordan and by Prof. J. P. Smith.

The material figured and described in the present paper was discovered by Mr. Robert Anderson in a Pliocene formation of southern California and belongs to the Geological Department of Stanford University. Dr. Joseph Grinnell, director of the Museum of Vertebrate Zoology, and Mr. Gerrit S. Miller, Jr., curator of mammals of the United States National Museum, have greatly facilitated the writer's studies on fossil Pinnipedia by the loan of skeletons of the living pinnipeds for comparison. These fossil bones have been compared with a number of the living pinnipeds besides *Eumetopias*, notably with *Zalophus*, *Arctocephalus*, *Callorhinus*, *Odobenus*, *Monachus*, and *Mirounga*, as well as with other fossil genera, the descriptions of which are now in press. In this paper comparisons are made with *Eumetopias jubata* (No. 8821, Mus. Vert. Zool.), *Zalophus californicus* (No. 16296, U. S. Nat. Mus.), *Odobenus divergens* (No. 21331, U. S. Nat. Mus.), and *Mirounga angustirostris* (No. 15270, U. S. Nat. Mus.). The illustrations for this paper were made by Mrs. Frieda Abernathy.

Fossil remains of the family Otariidæ are very little known. There are several extinct otarids on record, but many of these are based on very scanty and dubious material. This statement is especially true of teeth of doubtful reference found in France. In North America no evidence for Tertiary otarids on the Atlantic Coast has been recorded. True, in 1905, described *Pontolis magnus* from beds belonging to the Empire formation at Coos Bay, Oregon, based on the occipital and basicranial region of the skull. No limb bones were described by True[1]

[1] True, F. W., Smithsonian Misc. Coll. (Quart. Issue), vol. 48, pt. 1, no. 1577, p. 48, Washington, D. C., 1905; Prof. Paper No. 59, U. S. Geol. Surv., Dept. Interior, pp. 144–147, pls. 21–23, Washington, D. C., 1909.

and thus far no limb bones have been recorded from the Empire formation. Until such are found, it will be impossible to show the relationships of *Pontolis* to other otarids known only from limb bones that have recently been discovered in the Tertiary deposits of the Pacific Coast. *Desmatophoca oregonensis*[2] from Yaquina Bay, Oregon, has much the same status, as nothing more than the skull and the lower jaw have been recorded. Both of these specimens belong to considerably older formations than the Paso Robles. No fossil walrus remains have thus far been described from the Pacific Coast of North America, and their apparent absence from Tertiary deposits of this coast has not been satisfactorily explained.

The fossil pinniped discussed in this paper has many characters in common with the genera *Eumetopias* and *Odobenus*. The humerus resembles *Odobenus* in the thinness of the external margin above the outer condyle, and the extent to which the inner condyle is produced. The presence of a large articular surface for the trochlea on the head of the radius and a well-defined tubercle are additional points in common with the walrus. The large size of the ulna, especially the distal end, shows a further approach to the odobenid type. The position of the articular surfaces on the styloid process and the extent of the radial facet on the distal end of the ulna resembles *Eumetopias* more closely than *Odobenus*. The general appearance of the humerus, with the exception of the points previously mentioned, agrees with the otarid type.

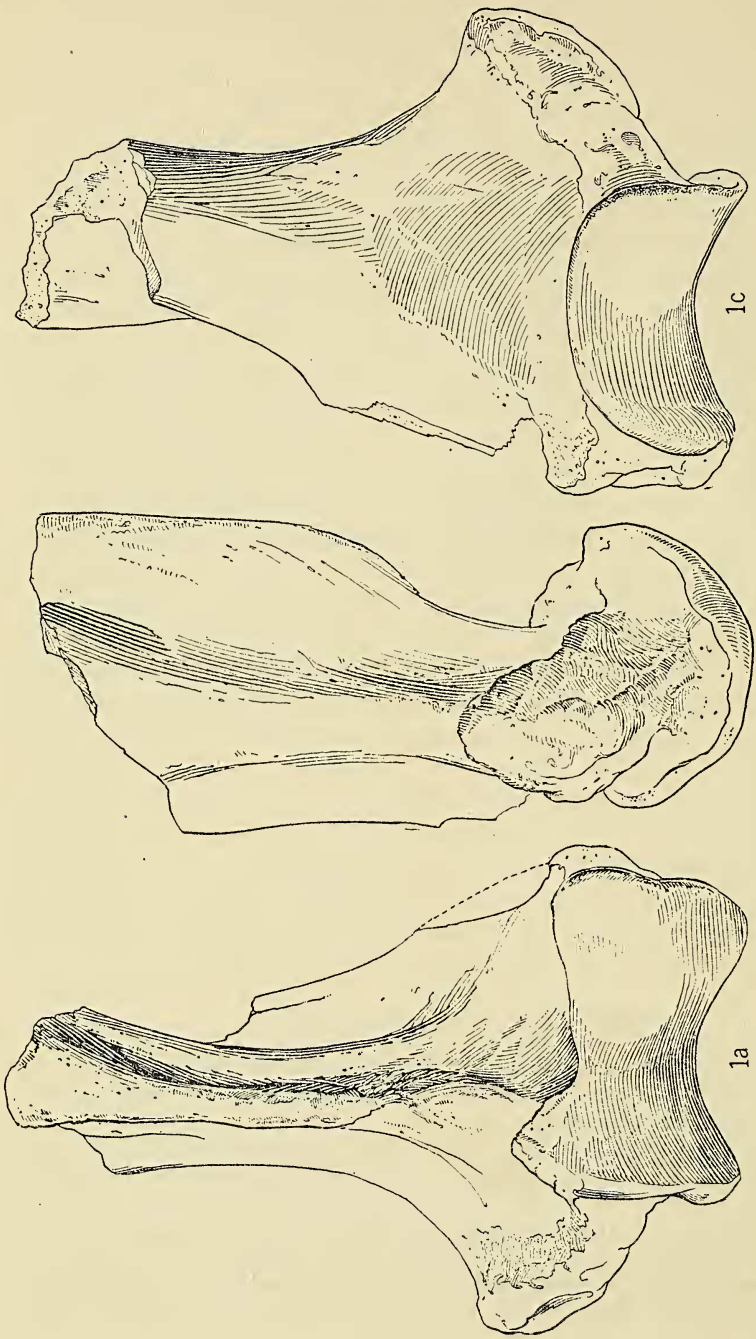
The possession of characters in common with both the Otariidæ and the Odobenidæ introduces a serious problem in the allocation of this fossil to its proper family. Moreover, since nothing is known concerning the skeleton of *Pontolis*, any determination must be regarded as more or less provisional. In consequence of these facts the writer tentatively refers this specimen to the family Otariidæ.

Pliopedia pacifica gen. et sp. nov.

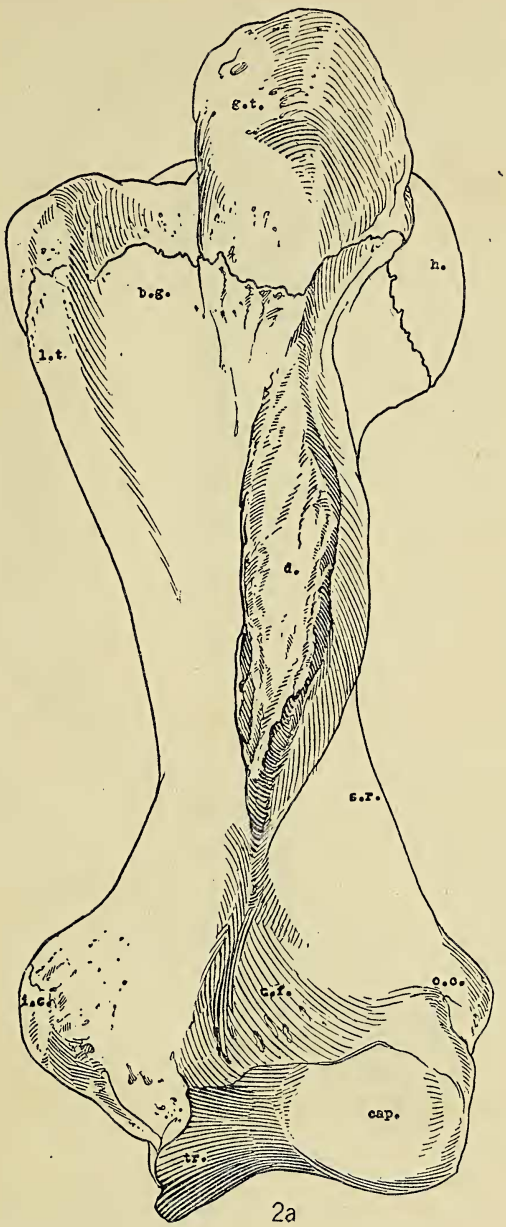
Type.—No. C. 537, Stanford University. Species based upon a number of incomplete bones including a humerus, radius, ulna, three metacarpals, two metatarsals, and three phalanges.

Locality.—In uncharted section of Township 29 South, Range 13 East (San Luis Quadrangle), on summit of hill one mile southeast of Santa Margarita,

[2] Condon, T., Univ. Oregon Bull., suppl. to vol. 3, no. 5, pp. 5–14, pls. 1–2, text figs. 1–3, Eugene, Oreg., 1906; Wortman, J. L., Science, n.s., vol. 24, no. 603, pp. 89–92, 1906; Hay, O. P., Proc. U. S. Nat. Mus., vol. 49, no. 2113, p. 383, Washington, D. C., 1915.



LEFT HUMERUS OF *Pliopedia pacifica* × ½ No. C. 537, STANFORD UNIVERSITY Santa Margarita, California: fig. 1a, anterior view; fig. 1b, internal view; fig. 1c, posterior view.



2a

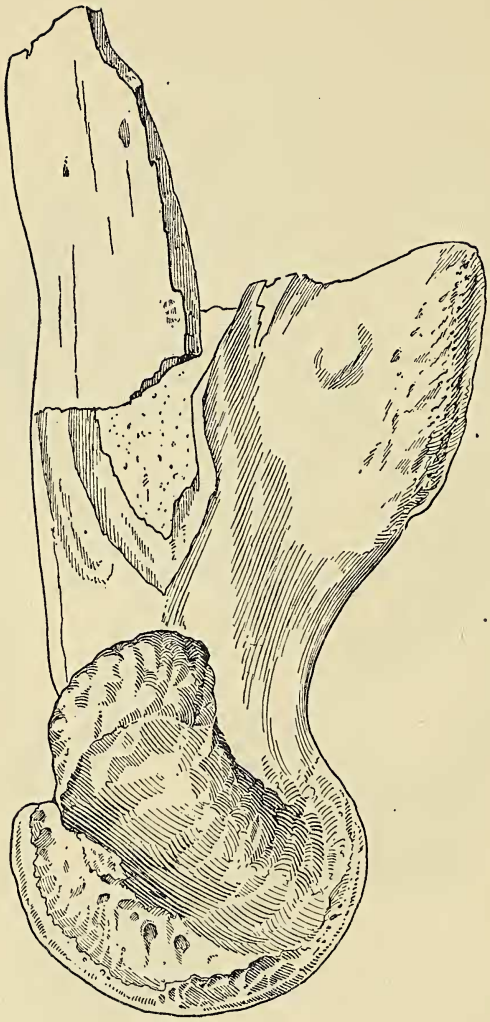
LEFT HUMERUS OF *Eumetopias jubata* × ½ No. 8821, MUS. VERT. ZOOL.

Año Nuevo Island, California: fig. 2a, anterior view. *b.g.* bicipital groove; *cap.* capitellum; *c.f.* coronoid fossa; *d.* deltoid process; *g.t.* greater tuberosity; *h.* head; *i.c.* inner condyle; *l.t.* lesser tuberosity; *o.c.* outer condyle; *s.r.* supinator ridge; *t.r.* inner trochlea.

LEFT HUMERUS OF *Eumetopias jubata* × ½, No. 8821, MUS. VERT. ZOOL. Año Nuevo Island, California: fig. 2b, internal view

LEFT HUMERUS OF *Trichecodon koninckii* × ½ (AFTER VAN BENEDEN, 1878, ATLAS, pl. 7, FIG. 1)

Antwerp basin, Belgium; fig. 3a, anterior view



LEFT HUMERUS OF *Trichecodon koninckii* × ½ (AFTER VAN BENEDEN, 1878, ATLAS, pl. 7, FIG. 2)

Antwerp basin, Belgium; fig. 3b, internal view

between Trout Creek and Yerba Buena Creek, San Luis Obispo County, California. The hill is probably the south one of the two 1,200 ft. knobs on the sheet.

Horizon.—The specimens were discovered by Robert Anderson in March, 1909, in a formation of gravel and sand overlying typical Santa Margarita beds. These beds are considered to belong to the Paso Robles formation of the Upper Pliocene.

The left humerus of this form differs very considerably from that of *Alachtherium cretsii*[3] and also from that of *Alachtherium antwerpiensis*[4] and to a less extent from that of *Trichecodon koninckii*[5] as figured by Van Beneden. Its most striking general characteristic is the antero-posterior compression of the distal end and the lateral compression of the shaft in the deltoid region.

When seen in front (fig. 1a), the shaft appears considerably narrowed at the middle, arcuate in outline externally, and flaring out suddenly internally at the distal end. The external border no doubt arose below the overhanging posterior hook of the head of the humerus, as in *Eumetopias jubata* (fig. 2a), for its superior margin is so directed while it widens out distally as the supinator ridge. The deltoid ridge is prominently developed and forms the sharp anterior edge of the shaft. The anterior margin of the deltoid crest folds over the external border of ridge in both *Eumetopias* and *Zalophus*, while in *Odobenus* the folding over is on the internal side. In *Mirounga* the deltoid ridge is low and the crest is uniformly rounded; this approximates more closely the type of deltoid ridge exhibited by this fossil humerus. However, the deltoid ridge itself curves or folds over the internal side to a slight degree in this fossil though not to such a marked extent as in *Odobenus*.

When viewed from the internal side (fig. 1b), the deltoid ridge is seen to curve prominently upward, though the antero-posterior diameter of the shaft in the deltoid region is not conspicuously wider than a lower trochlear portion, as is the condition in both *Eumetopias jubata* (fig. 2b) and *Trichecodon koninckii* (fig. 3b). This humerus resembles somewhat that of the common sea lion of the Pacific Coast, but is slightly smaller throughout than the humerus of the old male used for comparison, and a little broader at the distal end. The supinator crest is a little more flaring and sharp edged than in *Eumetopias jubata*, the trochlea is relatively wider, and the internal condyle is more produced. The external margin of the shaft is very thin and sharp edged in both *Odobenus* and this fossil. This margin is rounded in *Eumetopias* and *Zalophus* though in *Arctocephalus australis* it is slightly compressed and sharp edged.

The coronoid fossa is apparently quite deep in comparison with those of *Eumetopias jubata*, *Zalophus californicus*, or *Odobenus divergens*, though the exposed surface of the humerus in this area has suffered slightly from erosion. This fossa is bordered internally by a broad rounded ridge extending up towards the lower end of the obliquely placed deltoid crest. This ridge is considerably reduced in *Odobenus divergens* and is more prominent in *Zalophus californicus*

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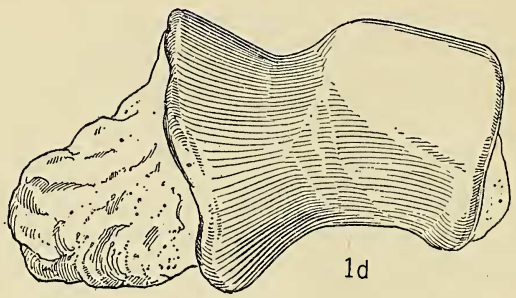
[3] Van Beneden, P. J., Ann. Mus. Roy. Hist. Nat. Belgique, Atlas, vol. 1, pl. 3, figs. 1–2; pl. 4, fig. 1, Bruxelles, 1878.

[4] Hasse, G., Bull. Soc. Belge de Geol., de Paleon., et d'Hydrol., vol. 23, Memoires, pl. 5, figs. 1–4; pl. 6, fig. 1, Bruxelles, 1910.

[5] Van Beneden, P. J., *op. cit.*, Atlas, pl. 7, figs. 1–2.

than in *Eumetopias jubata*. The inferior face of the shaft (fig. 1c) is somewhat flattened, being slightly twisted on the long axis from the external to the internal side. The surface of the shaft is missing in the area where the olecranon fossa should occur, extending inward as far as the inferior margin of the inner condyle.

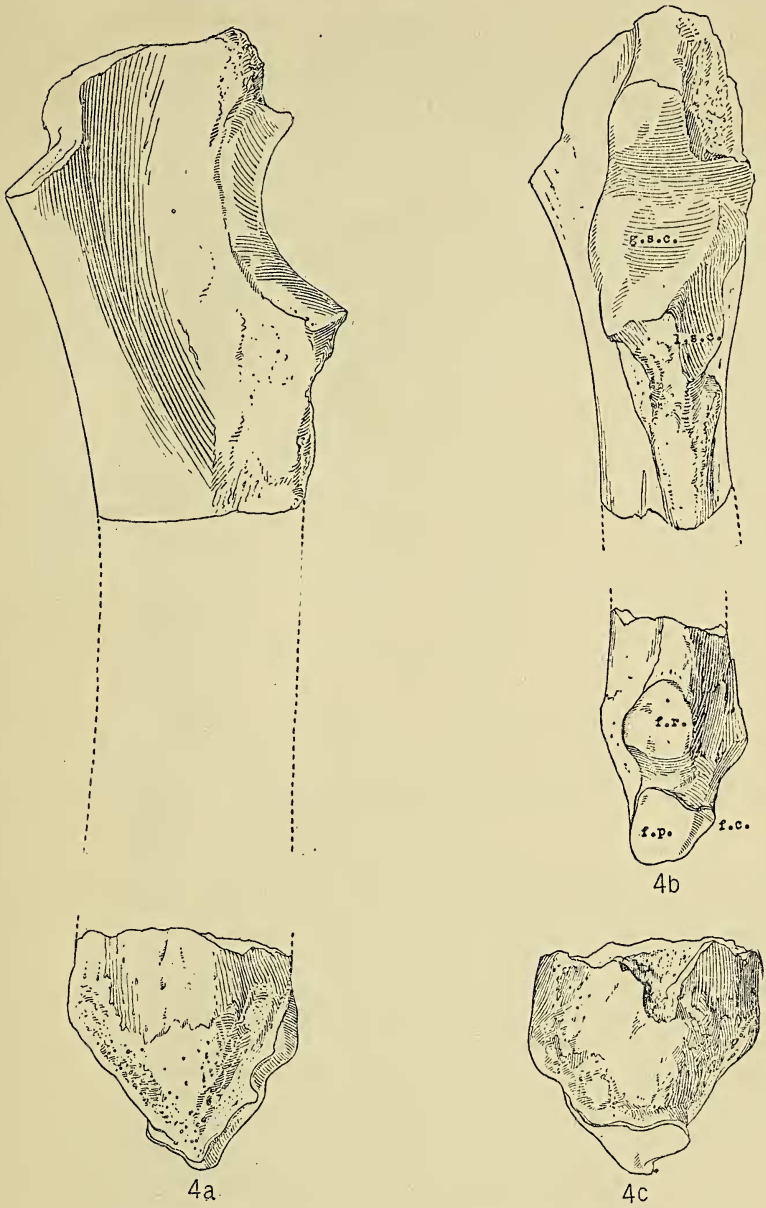


LEFT HUMERUS OF *Pliopedia pacifica* × ½, No. C. 537, STANFORD UNIVERSITY Santa Margarita, California: fig. 1d, distal view

The trochlear surface (fig. 1d) for articulation with the bones of the forearm is divided into an outer and less convex capitellum articulating with the radius, and a trochlea articulating almost entirely with the ulna, though to some extent with the inside of the proximal facet of the radius. From an inferior view (fig. 1c.), the trochlea is observed to be convex from above downward and concave from side to side. It is limited internally, externally, and proximally by a sharp crest.

The inner condyle is a triangular tuberosity projecting internally and slightly backward; its anterior surface is a continuation of the internal surface of the shaft and is bounded medially by the coronoid fossa. The outer condyle is much less prominent than the inner. The external surface is a continuation downward of the supinator ridge. It is convex from above downward, forming a shallow crescentic concavity between its inferior margin and the rounded edge of the capitellum.

In its general form the ulna (fig. 4a) was undoubtedly much like that of *Eumetopias jubata* (fig. 5), or that of *Odobenus divergens*, but with the distal end much stouter and broader. It is very much larger than the radius, as in other pinnipeds. The olecranon process and the proximal end of the ulna beyond the semicircular greater sigmoid cavity are missing. This articular surface on the anterior face of the ulna for the trochlea of the humerus is characterised by an evenly concave curve, wider above than below; its proximo-distal diameter (fig. 4b) is proportionately greater than in *Eumetopias jubata*. Immediately below the greater sigmoid cavity and on the external face there is a shallowly concave articular surface which receives the head of the radius. Below this lesser sigmoid cavity is a small rounded tuberosity which articulates with the tubercle on the postero-internal margin of the shaft of the radius (fig. 6c). No trace of this tuberosity is observed on the ulna of *Odobenus divergens* or of *Zalophus*



LEFT ULNA OF *Pliopedia pacifica* × ½, No. C. 537, STANFORD UNIVERSITY

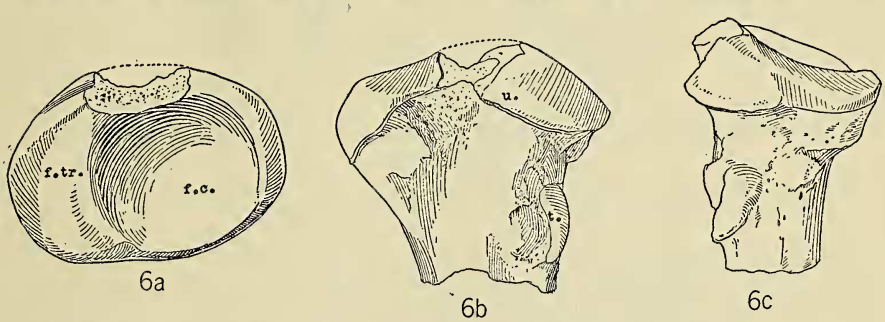
Santa Margarita, California: fig. 4a, internal view; fig. 4b, anterior view; fig. 4c, external view distal fragment. *f.c.* facet for cuneiform; *f.p.* facet for pisiform; *f.r.* facet for radius; *g.s.c.* greater sigmoid cavity; *l.s.c.* lesser sigmoid cavity.

LEFT ULNA OF *Eumetopias jubata* × ½, No. 8821, MUS. VERT. ZOOL. Año Nuevo Island, California: fig. 5, internal view

californicus, though a very rudimentary one is found on that of *Eumetopias jubata*. The coronoid process is broken off.

The shaft of the ulna is sub-triangular in section. In the area of the greater sigmoid cavity the shaft is convex on the external face and deeply concave on the internal; the posterior margin of the shaft is twisted towards the internal side. The external face of the ulna below the greater sigmoid cavity in both *Odobenus* and *Eumetopias* is concave.

The distal end is considerably enlarged in contrast with that of *Eumetopias jubata*. The articular facets are not sharply marked off from the roughened shaft. The articular surface on the anterior border for articulation with the radius (fig. 4b) is separated from a similar surface for the pisiform by a shallow groove. This facet for the radius is slightly convex; it faces forward and slopes slightly to the internal margin. The styloid process (fig. 4c) has two articular



LEFT RADIUS OF *Pliopedia pacifica* × ½, NO. C. 537, STANFORD UNIVERSITY

Santa Margarita, California: fig. 6a, proximal view; fig. 6b, posterior view; fig. 6c, internal view. *f.c.* facet for capitellum of humerus; *f.tr.* facet for inner trochlea of humerus; *t.* tubercle; *u.* ulnar facet.

surfaces, one for the pisiform and the other for the cuneiform, the contact being oblique in both cases. Both of these articular surfaces are slightly concave.

The proximal end of the radius (fig. 6a) is suboval in shape, as in *Odobenus divergens*. The facet for the capitellum is of considerable extent and strongly concave; it slopes downward from the ulnar to the anterior margin of the head. This facet is continuous internally with the convex articular surface for the trochlea of the humerus. The trochlear facet slopes downward to the internal margin of the head of the radius. It is also continuous posteriorly with the ulnar facet. In general form the head of the radius approaches very closely that of *Odobenus divergens*, the ulnar facet (fig. 6b) being comparatively flat, permitting of but a limited degree of rotation with the lesser sigmoid cavity of the ulna. It differs from both *Eumetopias jubata* and *Zalophus californicus* in the extent of the facet for the trochlea, which is considerably reduced in these two forms.

The neck is clearly defined on all sides. The tubercle (fig. 6c) is located on the postero-internal margin of the shaft, its superior margin terminating 18 mm. below the inferior margin of the ulnar facet. Adjacent to it there is a low rugose tuberosity. The tubercle is subtriangular in outline; its greater diameter is

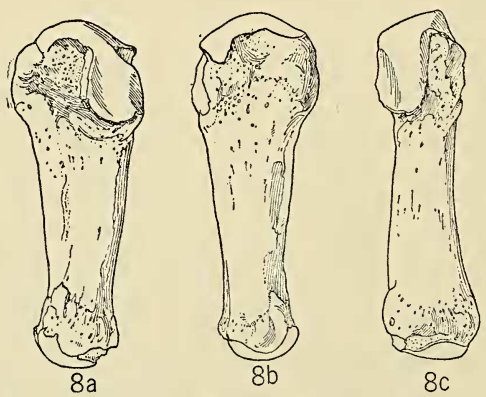
20 mm. and it terminates below in a bluntly pointed apex. A tubercle similar in shape is present in *Zalophus californicus*, though only a scar marks its presence on the radius of *Eumetopias jubata*. In *Odobenus divergens* the tubercle and tuberosity of the fossil are represented by a pair of flattened adjoining articular surfaces.

The structure of the carpus is unknown and it is hoped that future geological work in this region will result in the accumulation of additional material. The metacarpals are relatively slender and slightly enlarged at their articulations.

RIGHT METACARPAL I OF *Pliopedia pacifica* × ½, No. C. 537, STANFORD UNIVERSITY

Santa Margarita, California: fig. 7a, dorsal view; fig. 7b, proximal view

The first metacarpal of the right fore limb (fig. 7a) differs from the others in its larger size and in the shape and direction of its proximal articular surface. Its proximal surface (fig. 7b) for articulation with the trapezium is convex from the dorsal to the palmar border and concave transversely. On the ulnar face is a concave articular surface for the corresponding facet on the head of the second. The shaft is sub-triangular in outline; immediately below the proximal facet and



LEFT METARCARPAL III ? OF *Pliopedia pacifica* × ½, No. C. 537, STANFORD UNIVERSITY

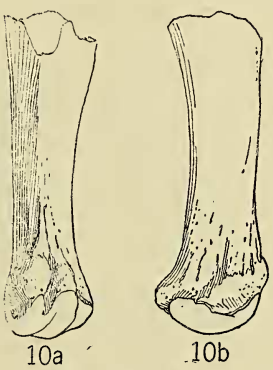
Santa Margarita, California: fig. 8a, radial view; fig. 8b, ulnar view; fig. 8c, dorsal view.

on the dorsal face there is present a shallow depression. On the radial face of the head are two smooth surfaces; one is somewhat flattened and slopes obliquely to the palmar face; the other is slightly concave and faces proximally. The palmar face of the shaft on the proximal end is strongly concave.

The determination of the remaining four bones is very difficult, owing to the want of a complete series of the bones of either the metacarpus or the metatarsus. Moreover, the similarity of these elements to one another introduces another element of doubt when one attempts by comparison with living otarids to allocate these bones definitely. In consequence of these difficulties the following determinations of these bones must be regarded as more or less provisional.

RIGHT METATARSAL II ? OF *Pliopedia pacifica* × ½, No. C. 537, STANFORD UNIVERSITY
Santa Margarita, California: fig. 9, proximal view

The best preserved of these four bones is assumed to be the third metacarpal on the left side. Its proximal surface is strongly concave from before backward. This surface is continuous with a shallowly concave facet (fig. 8a) on the radial face. On the ulnar surface of the base (fig. 8b) near the dorsal border is a concave facet for articulation with the adjoining metacarpal. This third metacarpal is somewhat expanded at the base and to a less extent at the head (fig. 8c); the shaft curves inward to a greater degree than is normal in *Eumetopias*.

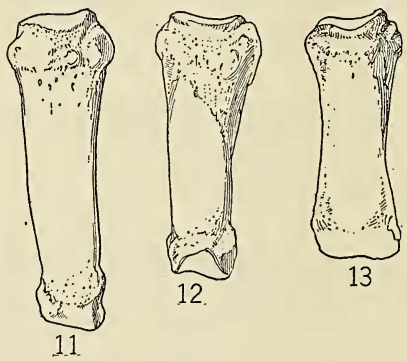


RIGHT METACARPAL IV ? OF *Pliopedia pacifica* × ½, No. C. 537, STANFORD UNIVERSITY
Santa Margarita, California: fig. 10a, plantar view; fig. 10b, tibial view

Among these four is the base of what is considered to be the second metatarsal. Its proximal end (fig. 9) is triangular in outline; the articular surface slopes from the plantar to the dorsal border and is concave from side to side. On the tibial margin is a rounded process for the internal cuneiform, and more proximally and nearer the plantar border is a second facet for the same element.

The base of the next bone to be considered is missing, and there is nothing distinctive about the shaft (fig. 10a) to indicate its true position, though possibly it may be the fourth metacarpal. The shaft (fig. 10b) is somewhat curved from the base to the head.

The fourth bone to be discussed consists of a fragment of the base of what appears to be the fifth metatarsal but this lacks the epiphysis. It has not been figured and with the exception of the flattened triangular outline of the shaft and the long dorso-plantar diameter, there is nothing particularly distinctive about it.



PHALANGES OF *Pliopedia pacifica* × ½, No. C. 537, STANFORD UNIVERSITY

Santa Margarita, California: fig. 11, dorsal view of second phalanx; fig. 12, dorsal view of third phalanx; fig. 13, dorsal view of fourth phalanx.

The phalanges of the forefoot were apparently very similar to those of *Eumetopias jubata*, judging from the three which were collected. There is nothing remarkable or unusual about these bones, for they agree in all their principal features with those of *Eumetopias* and differ only in minor details of the facets and in the curvature of the shafts. The proximal facet on the base of the second phalanx is concave from side to side; the curvature of the shaft (fig. 11) is toward the radial side, and the facet on the head is convex from above downward. It is considerably longer than the third or fourth phalanx. The third phalanx (fig. 12) is much stouter and shorter than the second and is essentially the same as the corresponding phalanx of *Eumetopias jubata*. The fourth phalanx (fig. 13) is slightly shorter and relative stouter than the third, and the head is equal in width to the base.

Bureau of Biological Survey, Washington, D. C.